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## Integrating Cognitive Linguistics and language evolution research

**Abstract.** In this paper we argue that we can gain important insights on the evolution of language and cognition by integrating evolutionary linguistics and the framework of Cognitive Linguistics. In Cognitive Linguistics, language is seen as tightly integrated with cognition as a whole. Construction Grammar and usage-based approaches are closely related to the Cognitive-Linguistic paradigm. Construction Grammar proposes that knowledge of language can be defined as the knowledge of form-meaning pairings of different degrees of schematicity and complexity, whereas usage-based approaches stress that language acquisition and processing are based on instances of actual language usage. As we demonstrate in this paper, concepts from Cognitive Linguistics, Construction Grammar, and usage-based approaches can help in elucidating the cognitive and interactional factors involved in language evolution. The paper will focus on two main areas: In evolutionary linguistics, language is seen as a complex adaptive system whose structure emerges out of the interaction of three other complex adaptive systems at three different timescales: ontogeny, glossogeny, and phylogeny. Cognitive Linguistics can help in specifying common cognitive factors and processes that play a role on all three of these timescales. Secondly, a Cognitive-Linguistic and constructionist, usage-based perspective can shed light on the cognitive factors underlying the origin of the division of labour between *contentful* (“lexical”) and *procedural* (“grammatical”) constructions in language structure. In a Cognitive-Linguistic perspective, this development can be related to the trade-off between the cognitive factors of *learnability* and *expressivity*.

**Keywords:** Evolutionary Linguistics, Language Evolution, Complex Adaptive System, Interdisciplinary Integration, Cognition, Cognitive Linguistics

## 1. Introduction

In this paper, we argue that there is a wealth of relevant research and theorizing in Cognitive Linguistics that can make important contributions to the study of the evolution of language and cognition. Specifically, we will argue that CL is very well-suited to specify the complex set of the underlying cognitive skills, capacities and processes that language use, structure, acquisition and evolution depend on. Furthermore, we argue that Cognitive Linguistics and evolutionary linguistics are ideally suited for integration as they both adopt a view of language as a complex adaptive system. In evolutionary linguistics, the complex adaptive system of language is seen as consisting of three interacting timescales. These in themselves each are complex adaptive systems, and they are all relevant to the emergence of the complex adaptive system of language: *ontogeny* (the level of the individual learning a language), *glossogeny* (the level of historical language change in populations) and *phylogeny* (the level of the biological evolution of the species) (Beckner *et al.* 2009; Kirby 2012; Kirby and Hurford 2002). A Cognitive-Linguistic perspective can help identify common patterns and factors that are relevant to all three timescales. In this way, Cognitive Linguistics can make significant contributions to evolutionary linguistics by showing how cognitive and usage factors play a role in all three complex adaptive systems that are involved in the emergence of language. In adopting a complex adaptive system perspective on language, CL can thus help to investigate cognitive, socio-cultural, embodied, conceptual and other factors involved in the evolution of human language on all three levels.

Cognitive Linguistics (CL hereafter) is a school of linguistic theory and practice that sees language as an integral part of cognition and tries to explain linguistic phenomena with relation to general cognitive capacities (e.g. Evans and Green 2006; Geeraerts and Cuyckens 2007). Language, in this view, is seen to draw on mechanisms and principles that are not language-specific but general to cognition. CL is closely related to so-called usage-based approaches (e.g. Barlow and Kemmer 2000) as well as to Construction Grammar (e.g. Hoffmann and Trousdale 2013). In combination with CL, these approaches have important implications for evolutionary linguistics, which we will address in this paper.

Usage-based approaches explain language structure as being based on processes of abstraction and schematization from instances of actual language use in context. In these approaches, the formation of linguistic structure is argued to proceed via the repetition and entrenchment of patterns in language use in richly social interactive contexts which get conventionalized in a community. Cognitive and communicative processes employed in interaction feed into and shape the emergence of linguistic structure (Bybee 2010; Ellis 2013). Usage events and the strategies and cognitive processes employed by language users in actual language use thus become the key focus of interest in this approach. This has important ramifications for research on language evolution, which similarly sees language as emerging ‘bottom up’ through the interaction of multiple complex adaptive systems. One of the key questions from a usage-based perspective then becomes how linguistic constructions emerge through language use and build a constructional network.

In Construction Grammar, and constructionist approaches more generally, language is seen as a structured inventory or network of constructions, which are defined as form-meaning pairings with varying degrees of schematicity and abstractness (Goldberg 2006; Hilpert 2014).

Such form-meaning pairings include fully specified constructions such as morpheme constructions (e.g. *anti-*, *un-*, *-ing*), word level constructions (e.g. *bear*, *banana*, *but*), as well as partially filled constructions (such as *[AGENT] crane [AGENT]+POSS neck*, cf. Langacker 2008) and idioms (e.g. *kick the bucket*, *jog X's memory*). At the most abstract pole of the continuum of constructions they include fully abstract constructions such as the Ditransitive Construction, which has an abstract, schematic meaning of transfer (*SUBJ V OBJ1 OBJ2*, e.g. *He baked her a vegan cupcake*), or the Caused-Motion-Construction (*S V OBJ ADV*, e.g. *She sneezed the napkin off the table*) (Goldberg 2006).

Cognitive-Linguistic research is driven by a number of core assumptions (Geeraerts 2006). These also have important implications for studies of the evolution of language (Pleyer 2012). First of all, in CL language is seen *symbolic* and *conceptual*: Language expresses and evokes conceptualizations, using particular cultural models and cognitive resources (Fauconnier 2004; Langacker 2008; Croft and Cruse 2004). Linguistic utterances thus function as instructions or “prompts” for the dynamic construction of a mental representation by the hearer (e.g. Evans and Green 2006). Following from this, CL also focusses on the *interactive* nature of language. The main function of language on this view is the dynamic, collaborative construction of meaning in interaction. Finally, the conceptual and interactive functions

of language also entail that language is fundamentally *perspectival*: all linguistic expressions and conceptualizations are always tied to a specific perspective or point of view. In CL, this general phenomenon is captured with the concept of *construal*: when speakers structure a conceptualization for purposes of expression, they structure it in a specific manner (Langacker 1987: 126). Language enables speakers to express different conceptual perspectives on the same referent, situation, or event. The structured inventory of constructions which language users possess enables them to construe a situation in many different ways and from multiple perspectives (Geeraerts 2006). Speakers have available different construal operations in their language that enable them to assign salience to different aspects of a conceptualization. In this way, the same conceptual content can be viewed and construed in different ways (Langacker 2008: 43f.). For example, the same conceptual content, e.g. a glass that contains water, can be linguistically construed in different ways:

*(1) the glass with water in it; (2) the water in the glass; (3) the glass is half-full (4) the glass is half-empty.* (Langacker 2008: 43)

One of the main goals of CL is to uncover the cognitive capacities and mechanisms that support and underlie the symbolic, conceptual, interactive, and perspectival nature of language. It is in regard to this that CL can make significant contributions to evolutionary linguistics (cf. Pleyer 2012). Some recent work has already begun to apply Cognitive-Linguistic insights to questions of language evolution and change (e.g. Bybee 2012; Sinha 2009; Tomasello 2008).

As we will outline, one particularly fruitful point of contact is that in evolutionary linguistics language is treated as a complex adaptive system (henceforth, CAS; Steels 2000; Mufwene 2001). Importantly, this perspective of language as a CAS has also been adopted in Cognitive-Linguistic and usage-based approaches (Beckner *et al.* 2009; Winters *et al.* 2010). On this view, language is seen as an emergent product of the interaction of multiple dynamical systems.

There are two areas closely related to the complex adaptive system perspective in which we will show that insights from CL can help in tackling problems in evolutionary linguistics.

The first concerns the problem of linkage between our biological capacity for language and the structure of language. This problem can be solved by looking at the cognitive factors involved in learnability and expressivity in combination with the dimension of sociocultural transmission.

The second avenue where CL can help in elucidating problems in evolutionary linguistics is the origin of the contentive/functional divide in language. Here, we argue, constructionist concepts of grammaticalization and constructionalization can give important insights into how this divide might have originated in the evolution of language.

In the next section (2), we turn to the notion of complex adaptive systems and illustrate the implications of research in CL and usage-based approaches for the ontogenetic (2.1), glossogenetic (2.2) and phylogenetic (2.3) timelines of the complex adaptive of system of language. Then we will turn to two specific case studies that show how CL and usage-based approaches offer a promising perspective to the study of language evolution. First, we will turn to the problem of linkage and the cognitive factors that influence the relationship between language strategies and language systems (3). Then we will address the evolution of the division of the contentive/functional divide (4), before offering some concluding remarks (5).

## 2. The three complex adaptive systems of language

The term complex adaptive system (CAS) was first coined by Holland (1992). CAS are similar to other complex systems in that they exhibit emergent properties as a result of multiple interconnected elements. But it is their capacity to evolve, learn and adapt that ultimately differentiates them from other complex systems: past experiences filter through, or influence, future states of the system due to a cumulative process (Deacon 2010). Like evolutionary (Whitacre and Bender 2010) and developmental (Edelman and Gally 2001) systems, language displays all the hallmarks of a CAS:

- (a) The system consists of multiple agents (the speakers in the speech community) interacting with one another.
- (b) The system is adaptive; that is, speakers' behavior is based on their past interactions, and current and past interactions together feed forward into future behavior.
- (c) A speaker's behavior is the consequence of competing factors ranging from perceptual mechanics to social motivations.
- (d) The structures of language emerge from interrelated patterns of experience, social interaction, and cognitive processes. (Beckner *et al.* 2009: 2)

A CAS perspective can show how general properties emerge from local interactions via an amplification dynamic: large ensembles of interacting elements become expressed as system-wide characteristics as a result

of interacting constraints and biases (Deacon 2010: 124). As we discuss in section 3, solving local communication problems through short-term strategies, such as usage events, can lead to the emergence of long-term patterns and structures that form language systems. In turn, these language systems then constrain the types of strategies that speakers employ. This idea of feedback loops that exist on multiple timescales is shared in much of the current work in evolutionary linguistics. Here, language arises through the interactions of three complex adaptive systems operating on different timescales (Kirby 2012):

1. The *ontogenetic* timescale of individuals acquiring language
2. The *glossogenetic* timescale of historical language change
3. The *phylogenetic* timescale of the evolution of the species.

In this section, we will show that a Cognitive-Linguistic perspective can direct attention to important factors that operate at these levels.

## 2.1. The ontogenetic timescale of individuals acquiring language

On the *ontogenetic timescale*, Cognitive-Linguistic and usage-based approaches focus on the cognitive factors and social scaffoldings influencing the acquisition and learning of language.

In other words, these approaches focus on the factors underlying learnability and expressivity in acquisition, which will be dealt with more thoroughly in sections 3 and 4.

Two general kinds of factors are seen to support the acquisition of language: *sociocognitive capacities and motivations* on the one hand and *domain-general cognitive mechanisms* on the other. The sociocognitive capacities that support language acquisition include processes of mutual coordination and cooperation, joint attention, shared intentionality, and perspective-taking (cf. Clark 1997; Tomasello 1999, 2008). Joint attention is the ability to attend to the same situation together with another person in triadic engagement. In this form of engagement attention is directed at both the other and an event in the outside world. One particular area where the importance of sociocognitive capacities is especially evident is that of word learning. For example, human infants reliably use gaze following to learn about objects and events from 12 months onwards (Flom and Johnson 2011). At 18 months of age, children learn to associate a word with the object the adult is looking at, not the one they are looking at (Baldwin and Moses 2001). At 24 months, children associate a new word with an object that is new from the adult's perspective, but not from their own (Akhtar *et al.* 1996). As

experimental evidence from infants as young as 14 month olds shows, this latter ability rests on a rudimentary but steadily developing understanding of perspectives in interaction (Moll and Tomasello 2007; Tomasello and Haberl 2003).

Overall then, the sociocognitive foundations of language acquisition are already evident in the production and comprehension of declarative pointing in prelinguistic infants. This is especially interesting as these capacities appear not to be present in non-human primates to the same degree (Tomasello 2008; Miklosi and Soproni 2006). Infants at the age of 12 months already begin to show some species-unique ways of directing and sharing attention, such as holding things up so they can show them to others, or pointing to interesting situations and events. These pave the way for the acquisition of language as they establish a referential triangle between a “me,” a “you” and an “it” analogous to speaker, listener, and topic (Tomasello 2007: 1092). As Ibbotson (2011: 332) points out, this view of development “predicts there should be a close correspondence between language emergence and social-cognitive abilities and indeed research shows children’s emerging linguistic skills are predicated on their ability to engage in nonlinguistically mediated joint attentional activities.” These sociocognitive foundations thus can be seen as a crucial evolutionary foundation for the emergence of language. Another important sociocognitive foundation that is already present at 14 months of age in humans, but absent in non-human species, is *shared intentionality*. Tomasello and colleagues have argued that shared intentionality is one of the most crucial foundations for language acquisition. It can be defined as the skills and motivations to form joint goals and intentions with others and to share psychological states with them (Tomasello *et al.* 2005; Tomasello 2008). Shared intentionality is tightly connected to another important sociocognitive prerequisite for learning and using language, namely understanding and establishing *common ground*. Understanding common ground means being able to understand others’ perceptions, engage with them in joint attention and create a common conceptual ground for joint understanding and cooperation. Their understanding of pointing gestures in cooperative situations shows that starting from 14 months onwards, young children become increasingly proficient in this task. In the context of language acquisition, this is particularly significant, as cooperative pointing rooted in common ground

creates different conceptualizations or construals of things. These presage the ability of linguistic creatures to place one and the same entity under alternative different ‘descriptions’ or ‘aspectual

shapes', which is one of the hallmarks of human conceptual thinking; but it does this without the use of any conventional or symbolic vehicles with articulate semantic content (Tomasello 2014: 57).

Pointing gestures thus already have the potential to embody different construals. For example, depending on the context and common ground, pointing at a piece of wood can construe it as firewood, an obstacle that needs to be removed, a crutch if you just twisted your ankle, a suitable weapon for a pretend play swordfight, etc. (cf. Tomasello 2014: 57).

These sociocognitive foundations are thus closely related to the notion of construal and a more generalised understanding of perspectives, which are crucial to children's language acquisition and sociocognitive development in general (Clark 1997; Moll and Tomasello 2007; Pleyer 2014).

From an evolutionary perspective, these sociocognitive capacities thus present important prerequisites for the emergence of language.

The general cognitive mechanisms employed by children when learning a language include, for example, statistical learning (e.g. Romberg and Saffran 2010), categorization (Taylor 2012; Bybee 2010), generalization and schematization (e.g. Langacker 2000; Ibbotson 2011), analogy (e.g. Gentner and Christie 2010), entrenchment (e.g. Lieven 2010), chunking and automatization (Bybee 2010).

In a usage-based perspective, children use their general cognitive abilities for pattern-finding to abstract concrete and specific items from instances of actual language use around them and then start generalizing over these concrete instance to arrive at more and more abstract constructional schemas (Tomasello 2003). Starting from 18 months onwards, children start using combinations of words, thus partitioning an experiential situation into several symbolic units. At the same age, young children also partition scenes conceptually by means of systematized pivot schemas. These kinds of multi-word utterances are organized locally around particular concrete words with one abstract slot, e.g. *More \_\_\_ : more juice, more play*, etc. (Tomasello 2011: 244). Starting around their second birthday, children start using some verbs in item-specific frames that are more complex, e.g., *Draw \_\_\_ ; Draw \_\_\_ on \_\_\_ ; Draw \_\_\_ for \_\_\_ ; \_\_\_ draw on \_\_\_*. In contrast to pivot schemas, these already employ some syntactic marking (Tomasello 2011: 245). In their second year of life children then begin to develop more abstract constructions that contain even less particular lexical items. In these constructions, the abstract slots have a clearly specified functional role and the constructions as a whole have specific communicative functions (Tomasello 2011: 246f.).

Taken together, these factors enable children to internalize the linguistic abstractions they make from instances of actual language use in context. That is, with the support of these mechanisms they acquire linguistic constructions that are grounded in context and common ground established through cooperative activity (Clark 1996; Tomasello 2014). Their knowledge of language, then, consists of a network of related perspectival constructions “in which the same event is construed from different perspectives so that speakers can choose the construction that is most appropriate to realize their communicative intention in a particular situation” (Diessel 2013: 357).

## **2.2. The glossogenetic timescale of historical language change**

On the *glossogenetic timescale*, cultural transmission and historical language change in dynamic populations are determined by social and cognitive factors as well as emergent properties of the transmission process (e.g. Deacon 2010; Hruschka *et al.* 2009; Kirby 2012). As will be discussed below in more detail, languages are shaped by the brain in such a way that they are learnable (Christiansen and Chater 2008; Deacon 1997; Brighton, Kirby and Smith 2005). Thus, languages adapt to be transmitted and learned through domain-general cognitive capacities and constraints. There is a multiplicity of constraints and factors, including constraints of body, brain, environment, and culture that play a role in this process. Given these constraints that influence the interactions and usage events of individual speakers, the process of transmission then leads to languages changing and gives rise to language structure. Generally speaking, in addition to the factors listed above, language structure and usage are “shaped around human learning and processing biases deriving from the structure of our thought processes, perceptuo-motor factors, cognitive limitations, and pragmatic constraints” (Christiansen and Chater 2008: 490). The specific nature of the process of cultural transmission and selection also plays a role in the shaping of language structure (Kirby 2012; Steels 2011), as do emergent properties related to cultural conventions, discourse factors, and semiotic constraints (Beckner *et al.* 2009).

The existence of domain-general biases also highlights the overall importance of development on the ontogenetic timescale. Humans show a great degree of developmental flexibility, which itself is seen as an evolutionary system (Deacon 2010). In human development, domain-general mechanisms act as slight biases, which allow developmental pathways to explore the functional space of the cultural environment.

As we will further illustrate in sections 3 and 4, CL and usage-based approaches can help to unravel the interaction of general cognitive mechanisms and cultural transmission in influencing language change and the emergence of structural patterns (e.g. Beckner *et al.* 2009; Bybee 2010; Christiansen and Chater 2008; Winters *et al.* 2010). Through the repeated interaction between individuals we can observe regular patterns of change at the glossogenetic level. Language emerges as a product of its underlying speech community, but also adapts to the very dynamics from which it emerged (Beckner *et al.* 2009). As Diessel (2012: 1609) points out, the cognitive processes of analogy, entrenchment, and categorization play an important role both in language acquisition and language change. These factors thus are not only crucial for language acquisition; they also enter into the glossogenetic emergence of linguistic structure. The cognitive factors discussed in this and the previous sections also interact with and influence construal: Speakers use their ability for perspectival construal when they use particular linguistic strategies to categorize and linguistically structure situations in specific ways. These perspectival choices influence linguistic structure through processes of entrenchment and conventionalization (see section 3, cf. Evans and Green 2006: 110). Entrenchment denotes “the strength of autonomy or representation of a form-meaning pairing at a given level of abstraction in the cognitive system” (Blumenthal-Dramé 2012: 4). Through usage events, linguistic structures that occur frequently in discourse and are salient become consolidated in memory, are processed sequentially and are stored in automated chunks (Bybee 2010). Again, these cognitive factors that affect the mental representation and processing of linguistic structure are domain-general in nature. This is stressed, for example, by Langacker (2008: 16):

Automatisation is the process observed in learning to tie a shoe or recite the alphabet: through repetition or rehearsal, a complex structure is thoroughly mastered, to the point that using it is virtually automatic and requires little conscious monitoring.

Automatisation leads to the progressive entrenchment of a structure, which

eventually becomes established as a unit. Lexical items are expressions that have achieved the status of units for representative members of a speech community (Langacker 2008: 16f.).

Through processes of analogy and categorization linguistic structures instantiated in usage events can also become more schematized and abstract.

Overall then, on this view domain-general processes serve as the basis for the emergence of grammar and linguistic structure (Bybee 2012).

Even though historical contingency is considered an important factor in diachronic language change (Lass 1997), there are also language-external biases and constraints that influence the continual cycle of innovation, amplification and fixation (Croft 2000). Still, these paths of change are far from pre-determined, with the trajectories of change being much more similar than the resulting states (Beckner *et al.* 2009: 7). Overall then, structural patterns emerge through processes such as grammaticalization (e.g. Beckner *et al.* 2009; Bybee 2010; Traugott and Trousdale 2013; see section 4).

Explaining the emergence of systematic structure through the processes of social transmission and interaction has become a central goal in the study of the cultural evolution of language (Scott-Phillips and Kirby 2010). This is why insights from CL and usage-based approaches could be highly profitable for this enterprise. In section 4, we will turn to one particular proposal how general cognitive mechanisms can influence language change, namely the division of labour in the construction between contentive and functional items (Kirby 2013).

### **2.3. The phylogenetic timescale of the evolution of the species**

On the *phylogenetic timescale*, CL focuses on the biological evolution of the species and of the uniquely human multi-component suite of skills that enables language learning and production (e.g. Tomasello 2003, 2008; Christiansen and Chater 2008). Consequently, CL can help specifying the cognitive and representational capacities that had to evolve beyond those found in other animals in order to support language and the interactive and dynamic processes of meaning construal fundamental to linguistic interaction. From a phylogenetic perspective, one of the key questions is to what extent the cognitive capacities discussed in sections 3.1 and 3.2 have homologues and analogues in other animals, especially the other great apes. This enterprise is well underway. Steels (e.g. 2004), Hurford (2012), Arbib (2012) and Bybee (2012), for example, have all adopted a constructionist or usage-based perspective on the question of language evolution and have specified some of the cognitive prerequisites that needed to evolve to make the human brain “language-ready” (Arbib 2012; cf. Pleyer and Lindner 2014). On the one hand, these concern the domain-general processes crucial to language acquisition and transmission discussed in sections 2.1 and 2.2. In addition, there are other important factors that such approaches can shed light on, such as the evolution of the cognitive capacity for “massive storage”

(Hurford 2012: 261ff.) of constructions and exemplar representations (Bybee 2012; Taylor 2012). In CL, meaning and linguistic knowledge are seen as encyclopaedic, i.e. they are tightly connected to our general knowledge of the world and other conceptual domains (Langacker 1987, 2008). Related to this, constructions are hypothesized to be stored much in the same way as other types of knowledge (Goldberg 1995; Bybee 2010; Traugott and Trousdale 2013). This means that from a phylogenetic perspective, the evolution of the ability for the massive storage of all types of representations was a key development enabling language-readiness. The domain-general capacities underlying language acquisition thus are also crucial for the constitution of a language-ready brain. These include statistical processing that is sensitive to frequency effects, abilities for categorization, generalization and schematization, which enable the recognition of analogical similarities between stored exemplars, and the processes involved in entrenchment, and neuromotor automation. Other evolutionary requirements are the ability to voluntarily retrieve form-meaning pairings from long-term memory and increased hierarchical processing capacity (Hurford 2012; Tallerman 2009; Pleyer and Lindner 2014). These and other domain-general abilities such as the ability to make inferences based on context and common ground, and the ability to cross-modally associate meanings with vocal or manual signals, also can be found to different degrees in non-human primates and other animals. However, “the human cognate capacities are much richer, both in detail as well as degrees of abstractness” (Bybee 2012: 536).

On the other hand, the cognitive prerequisites for language concern the socio-cognitive foundations of language discussed in the previous sections. Among these, the capacities for construal and reciprocal perspective-sharing in discourse characterized by shared intentionality seem to be among the most important. As Tomasello (2014: 68) puts it: “Communicators conceptualizing or perspectivizing things in different ways [...], and then recipients comprehending the intended perspectives through socially recursive inferences, is not the result of becoming a language user, but rather its prerequisite.” Similarly, Tomasello *et al.* (2005: 690) emphasize that:

Saying that only humans have language is like saying that only humans build skyscrapers, when the fact is that only humans (among primates) build freestanding shelters at all. Language is not basic; it is derived. It rests on the same underlying cognitive and social skills that lead infants to point to things and show things to other people declaratively and informatively, in a way that other primates do not do, and that lead them to engage in collaborative

and joint attentional activities with others of a kind that are also unique among primates.

From a phylogenetic perspective, the evolution of the shared intentionality infrastructure is thus of crucial importance. These and other sociocognitive proclivities are already evident in humans from a very early age on and together with domain-general pattern-finding capacities build the foundations for language acquisition (Tomasello 1999, 2003, 2008). Evidence from comparative psychology suggests that other primates also possess a rich set of socio-cognitive capacities in the domain of understanding goal-directed actions, head orientation, eye orientation, and gaze. Moreover, great apes also exhibit at least rudimentary perspective-taking abilities. For example, “chimpanzees, like humans, understand that others see, hear and know things” (Call and Tomasello 2008: 190). However, the structure of social perspective-taking and -setting in humans goes well beyond the capacities exhibited by other primates. Humans do not only understand and take other people’s perspectives, but, in contrast to chimpanzees, they make use of their perspective-taking capabilities in fundamentally cooperative, declarative, and informative kinds of communication (cf. Tomasello 2008). Chimpanzees, for instance, have trouble understanding perspectives in non-competitive, cooperative interactions and neither produce nor understand declarative, perspective-sharing pointing gestures. As has been outlined in section 2.1, in human children, on the other hand, this ability and motivation is a crucial foundation for the acquisition of language (cf. Tomasello 2003, 2008). This means that the evolution of the human drive to share perspectives and psychological states with others was of fundamental importance in the evolution of language. Biological factors underlying these prosocial cooperative motivations and the drive to share perspectives and attitudes are thus among the key evolutionary adaptations that enabled the evolution of human language. Overall, then, on the phylogenetic dimension, CL directs attention to the evolution of the factors underlying the learnability and expressivity-functions of a network of constructions, a point that we will elaborate on in the next sections.

### 3. Solving the problem of linkage

In developing an explanatory framework in linguistics, we need to take seriously the disconnect between *explanans* (our biology) and *explanandum* (language structure): that is, we are faced with a *problem of linkage* (Kirby

1999, 2012). Rather than there being a straightforward link between our individual cognitive machinery and the features we observe in language, we are instead faced with an additional dynamical system: *socio-cultural transmission*. Treating language as a CAS (see section 2) solves this problem of linkage because we can consider how short-term *language strategies* (Evans and Green 2006: 110) can give rise to *language systems* through long-term patterns of learning and use (Bleys and Steels 2009; Steels 2012).

Language strategies are heuristics an idiolect draws upon to convey their interactional goal and include the use of speech acts and our choices over constructions (Evans and Green 2006). Take the relatively simple example of referentially signalling a particular *pool ball*. Besides non-linguistic strategies, such as pointing, we can draw upon a whole host of referential labels, such as *ball*. However, these choices are constrained by the usage events and contexts in which they are situated. For example, in *fig. 1* the labels *ball* and *pool ball* would be useless, unless additional information is provided. This can be done through *compounding* (e.g., pass me the *cue ball*) or by providing referentially useful information on another dimension (e.g., pass me the *white*).

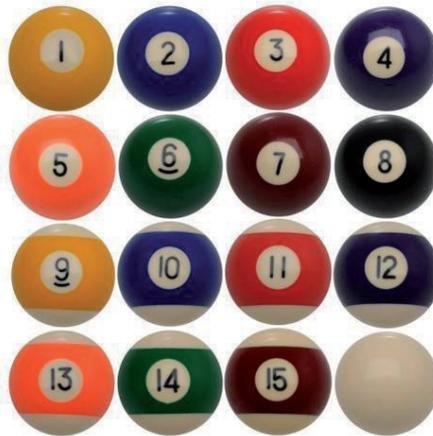


Figure 1. A collection of pool balls

A language system, then, is a collection of these strategies, which form a group of paradigmatic choices (Steels 2012). For instance, German features a case marking system made up of the paradigmatic choices of nominative, accusative, dative, and genitive. Importantly, not only do these strategies influence the emergence of linguistic systems, the linguistic systems themselves act as constraints on the choice of strategies (*ibid.*).

What strategies are used depends on a whole host of contextual factors that are particular to each usage event. This explains why we observe a high degree of historical contingency in the cultural evolution of language; that is, change proceeds generally via localised interactions (Lass 1997; Beckner *et al.* 2009). Still, even if we grant historical contingency a large role in language, we cannot avoid observations of systematic regularities both in how it is structured and how it changes over time. Predictable patterns of change, such as *grammaticalization* (see section 4), are argued to underpin general, cross-linguistic patterns of similarity (cf. Evans and Levinson 2009; Beckner *et al.* 2009). What we want to claim for the rest of this section is that the factors governing linguistic strategies, and the subsequent emergence of linguistic systems, can broadly be classified under pressures for *learnability* and *expressivity* (Smith, Tamariz and Kirby 2013).

Learnability refers to our limited exposure to input data as well as domain-general limitations in our memory and processing capabilities (Christiansen and Chater 2008). Patterns that are difficult to learn are harder to reproduce (Brighton, Kirby and Smith 2005). However, language is not merely a task of passively remembering and reproducing a set of constructions. Language is also a social and interactional phenomenon, whereby the role of usage, communication and coordination are salient pressures on the system (see also: Tomasello, 2008; Bybee, 2010; Winters, Kirby and Smith, 2014). This is the *expressivity pressure*.

It is only when there is a balance between these two pressures of *learnability* and *expressivity* that we do observe the emergence of systematic structure (Smith, Tamariz and Kirby 2013). If we remove the pressure for expressivity, then the learnability pressure gradually leads to a degenerate system consisting of one form for every meaning. Conversely, if we remove the learnability pressure, then we tend to get holistic systems where there is a non-systematic (arbitrary) one-to-one mapping between forms and meanings.

The take home point we want to stress is that these pressures of learnability and expressivity are acting locally on individual constructions and that they are strategically deployed in context. These strategies then become system-wide characteristics and influence the long-term emergence of language structure. Unifying cognitive and evolutionary linguistics provides a framework in which researchers can identify the cognitive machinery and processes underpinning learning and use, how linguistic systems change over time, and ultimately how they evolved in the first place. This allows us to ask the question how language evolved given its biological and cognitive machinery. That is, we can examine how languages pattern

synchronically, as well as how they change diachronically, and use this to infer what biological features underpin these processes.

#### 4. Division of labour in the constructicon

Common to many theories in linguistics is the notion of a division of labour between *contentful* (“lexical”) and *procedural* (“grammatical”) constructions (e.g., Talmy 2000). Generally speaking, contentful constructions are used referentially, whereas procedural constructions are normally considered more abstract, and signal linguistic relations, perspectives and deictic orientation (Traugott and Trousdale 2013): that is, they “contribute information about how to combine [...] concepts into a conceptual representation” (Terkourafi 2011: 358-359).

There is considerable debate over the nature of these divisions and what constitutes a member of one category over another (e.g., Cann 2001; Boye and Harder 2012; Traugott and Trousdale 2013). For instance, even though there is overlap in the descriptive terms such as *open class* and *closed class*, *lexical* and *grammatical*, *contentive* and *functional*, *contentful* and *procedural*, these terms are not always used in a strictly synonymous manner. One example is the gradation found in English adverbs. Manner adverbs, such as *foolishly* and *fast*, pattern on the contentful end of the continuum, while focus marking adverbs (*only* and *even*) and degree adverbs (*very* and *quite*) cluster on the procedural end (Traugott and Trousdale 2013).

Irrespective of how we choose to classify the division, and the degree to which these divisions are categorical or gradient, the point remains that there are observable patterns in the structure of language. With this in mind, Kirby (2013) considers the division of labour to be a major transition in the cultural evolution of language (alongside *combinatorial phonotactics* and *compositionality*), and posits that the emergence of these new replicators, with a specifically syntactic function, might be driven by processes we observe in language change, namely *grammaticalization*: “What remains an open question at this stage is if we can demonstrate that the same process leads to the emergence of the very first functional elements in the longer term emergence of language. In other words, did the process of grammaticalization lead to the original split in the lexicon in the first place?” (Kirby 2013: 135).

For Heine and Kuteva (2007) and Bybee (2010) the answer is in the affirmative: they see no *a priori* reason why the processes underpinning language change should have been fundamentally different for the emergence

of grammatical categories. Much of the modern debate on grammaticalization centres around two definitions (cf. Kiparsky 2012). The first of these sees grammaticalization as a process through which “the parts of a constructional schema come to have stronger internal dependencies” (Haspelmath 2004). This definition encompasses the set of changes in morphosyntactic form: Here, we observe a unidirectional process towards increasingly tightly bonded units that show loss of autonomy (Lehmann 2004). An example of this type of grammaticalization would be the following change: postposition > clitic or suffix (Kiparsky 2012). The second definition sees grammaticalization as an expansion of semantic-pragmatic, syntactic, and collocational range (Himmelmann 2004). An example of this type of change is when an epistemic modal acquires a deontic meaning (Kiparsky 2012).

Taking a constructionist and usage-based perspective, Traugott and Trousdale (2013) show how constructional changes take place within a network model, with these changes being characterised by the creation of new constructional nodes as well as the reconfiguration of links between nodes. These networks not only consist of micro-constructions, they also are hierarchically organised with there being groupings of nodes (schemas and subschemas). In terms of Traugott and Trousdale’s diagnostics, grammatical constructionalization is associated with an expansion of *productivity* (expansion both of type frequency and token frequency) and an increase in *schematicity* (shift towards procedural function and changes in schemas), but a reduction in the transparency between the form and meaning mapping of a micro-construction (*compositionality*). Importantly, grammatical constructionalization is seen as an outcome of the changes described, and is not considered a process (see also Joseph 2001). As such, the two definitions of grammaticalization as either expansion or reduction are not necessarily orthogonal in Traugott and Trousdale’s account: here, grammatical constructionalization involves *an expansion in the construction types and their range of use* and the *chunking and fixing of forms within the linguistic system*. As they note, “[E]xpansion is the logical outcome of attrition resulting from repetition and chunking” (p. 147).

Given that constructions are influenced by these basic cognitive mechanisms of learning and use, we can see how repetition, chunking and expansion provide the raw material through which procedural functions can arise. The motivation for the evolution of these procedural functions, then, is the need to expand the expressivity of the constructicon, without detrimentally impacting our learnability. Such problems become inevitable once we begin using language across a larger range of cognitive, contextual and socio-cultural niches. These notions echo those of Bybee (2010: 203):

Note that in this view, the first language or languages are thought not to be the same as present day languages. They would have had lexical items but not grammatical items or constructions. Grammar developed gradually as language was used and as the capacities of humans or our ancestors increased to accommodate a large vocabulary, more abstract categories and many automated sequences.

One tentative hypothesis we might draw from these accounts is that procedural functions are the result of language adapting to its own internal dynamic to solve pressures from learnability and expressivity. If language is expanding into new socio-cultural contexts and niches, and our strategic goal is to reduce uncertainty about the intended meaning whilst maximising our expressive capacity, then a construction made up of purely contentful constructions is constrained by the burdens of memory and processing as well as the need to coordinate on a shared system. In short, humans cannot go on indefinitely creating new contentful constructions. Procedural constructions provide a simple solution to this problem by expanding the ways in which a linguistic system can package information (see *Information Structuring*: cf. Goldberg 2014): that is, through a small set of procedural constructions we can greatly enhance a language's expressivity, without significantly impinging on learnability.

Through reusing a pre-existing inventory of contentful constructions, and applying procedural constructions as a way of modifying and signalling relations in a predictable way, we solve two problems simultaneously. First, the language is highly expressive, as pre-existing signals can be used to express new content. These *reuse strategies* are evident in any situation where we observe ambiguity and are advantageous in communication systems skewed towards hearer inference over speaker effort (Levinson 2000). In short, when the context is known and informative, it is a useful resource in decreasing uncertainty about the intended meaning (Piantadosi *et al.* 2012; Winters *et al.* 2014). Employing a reuse strategy allows a population of speakers to make use of contextual relevance, and our powerful inferential capacities, to expand the expressivity of the system without detrimentally impacting upon our capacity to coordinate a linguistic system across a community of speakers. Second, the *learnability problem* is solved, as the reuse of constructions allows for rate-limited growth in the construction. By limiting the number and types of new constructions, the burden on our memory and processing apparatus is significantly reduced.

Our account for the emergence of procedural constructions makes several predictions about the cognitive system and mechanisms underpinning

this division of labour. The first requirement is an inferential capacity that makes use of common ground and the communicative context to expand a pre-existing system of constructions (for recent accounts see Smith and Höfler 2014; Scott-Phillips 2014). Once this inferential capacity is in place, the process of cultural evolution frees up a communication system's ability to explore new functional spaces where contentful constructions take on a more procedural role. What pushes these previously contentful constructions into these new procedural spaces are the well-documented pressures of learnability and expressivity acting on multiple timescales to expand the construction types and their range of use within the linguistic system.

The account we have briefly sketched here offers some tentative hypotheses regarding the division of labour in the construction. Future work should aim to explicitly test these hypotheses through a combination of analytical models, computational simulations and laboratory experiments (Irvine *et al.* 2013).

## 5. Conclusion

There are many convergences and similarities between CL and evolutionary linguistics and the two disciplines can profit from interdisciplinary integration. Language exists at three timescales that dynamically interact with one another – it is a *Complex Adaptive System*. Integrating this view with research from CL can give crucial insights into important problems in evolutionary linguistics.

Unifying cognitive and evolutionary linguistics provides a framework in which researchers can identify the cognitive machinery and processes underpinning learning and use, how linguistic systems change over time, and ultimately how they evolved in the first place. This allows us to frame what evolved by asking how language evolved given its biological and cognitive machinery. That is, we can examine how languages pattern synchronically, as well as how they change diachronically, and use this to infer what biological features are necessary.

As CL sees the complex adaptive system of language as well as its evolution as relying on general cognitive capacities and factors, it also actively seeks to integrate converging evidence from other disciplines in cognitive science (Evans and Green 2006). This feature of CL thus makes this paradigm highly amenable to interdisciplinary integration and presents another reason why a synergetic dialogue between CL and language evolution research seems worthwhile. As we have shown, adopting a usage-based

and constructionist perspective, CL can shed light on the relation of socio-cognitive and domain-general factors on the one hand, and the emergence, acquisition, and use of language on the other. Specifically, CL can help elucidating the cognitive principles implicated in all three complex adaptive systems that are involved in the complex phenomenon of language: ontogeny, glossogeny, and phylogeny.

A crucial question, then, concerns the relative roles of cultural evolution and biological evolution in accounting for the underlying structural hallmarks of language. In this paper, we have alluded to a possible explanation of the contentful-procedural divide in terms of a trade-off of cognitive pressures for learnability and expressivity. This perspective can thus help us to gain insight into the cognitive foundations as well as the processes that influence language learning and use, as well as the emergence of language more generally.

By showing how general cognitive capacities can interact with cultural evolutionary processes, we might be able to extrapolate from well-attested processes observed in historical language change to the evolution of language. CL thus can make a significant contribution to the highly interdisciplinary study of language evolution.

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